Supporting Information

Precisely controlled resorcinol-formaldehyde resin coating for fabricating core-shell, hollow, and yolk-shell carbon nanostructures†

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Experimental section

Synthesis of ellipsoid-shaped α-Fe_2O_3@SiO_2 core-shell nanoparticles. The α-Fe_2O_3 spindles were synthesized by aging a solution containing 136 mg of $FeCl_3 \cdot 6H_2O$, and 2 mg of NaH_2PO_4 dissolved in 16 mL of deionized water at 180 ^oC for 6 h. For SiO_2 coating, 50 mg of as-prepared ellipsoid-shaped α -Fe_2O_3 was first dispersed in a mixture of isopropanol (100 mL), H_2O (20 mL), and ammonium (3 mL). Then 0.3 ml of TEOS was added under vigorous stirring every 4 h up to a total TEOS volume of 0.6 ml. The as-synthesized α-Fe_2O_3@SiO_2 core-shell nanoparticles were collected by centrifuging and then cleaned three times with water and ethanol.

Preparation HCS-260/sulfur composite and electrochemical measurement. HCS-260 and sulfur were mixed with a ratio of 1 to 3 and then treated at 150 ℃ to melt sulfur into the pores of HCS-260. The HCS-260/Sulfur cathode was created by mixing composite, Super P and polymer n-lauryl acrylate(LA) binder in the ratio of 7:2:1. Positive electrodes were produced by coating the slurry on aluminum foil and drying at 60 ℃ for 12 h. The cells for testing were assembled with CR2016-type stainless steel coin cells in an argon-filled glove box. Lithium metal was used as the counter electrode and Celgard 2400 polypropylene membrane was used as the separator. The electrolyte solution was dioxolane and 1, 2-dimethoxyethane (1:1 by volume) with 1.0 M $LiCF_3SO_3$ and 2% wt $LiNO_3$. Electrochemical charge-discharge, under the potential window 1.7 to 2.5 V, was carried out on Neware BTS-5V/5mA battery test system at the current density of 500 mA g^{-1}.

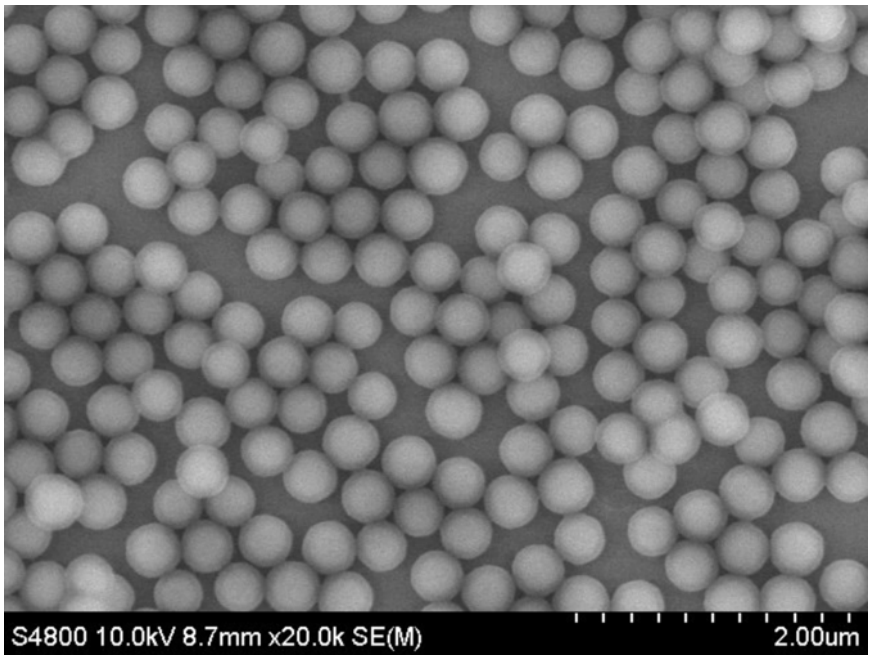

Fig. S1 SEM image of SiO_2@RF core-shell spheres

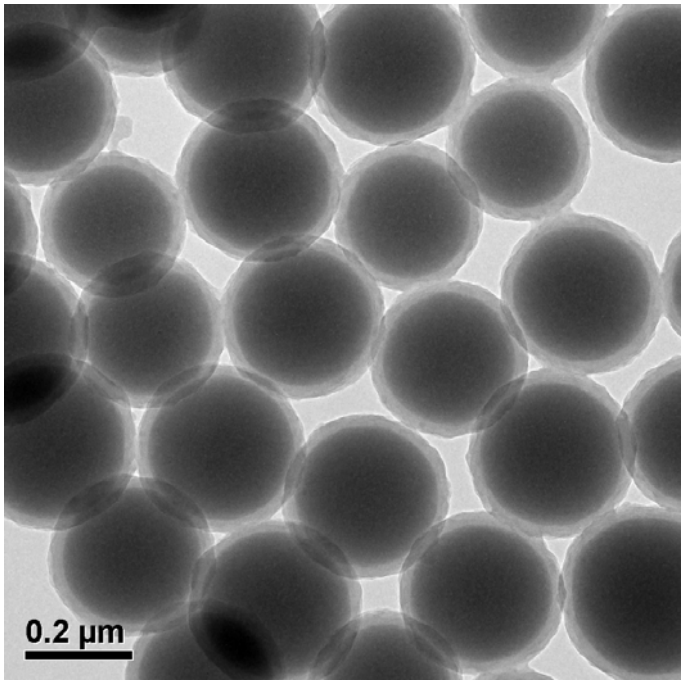

Fig. S2 TEM image of SiO_2@RF core-shell spheres obtained by replacing CTAB with CTAC.

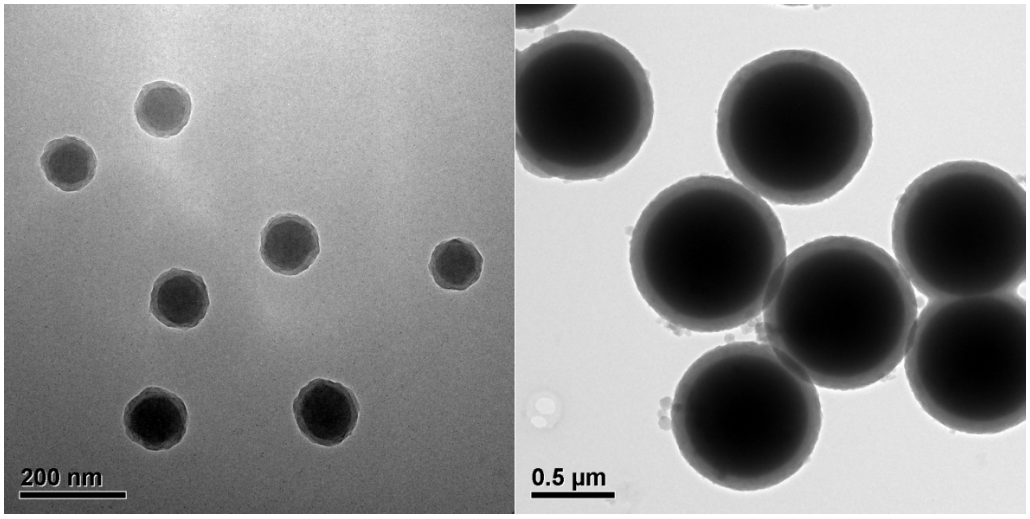

Fig. S3 TEM images of SiO_2@RF core-shell spheres with different diameter of SiO_2 cores: (a) 100 nm and (b) 750 nm.

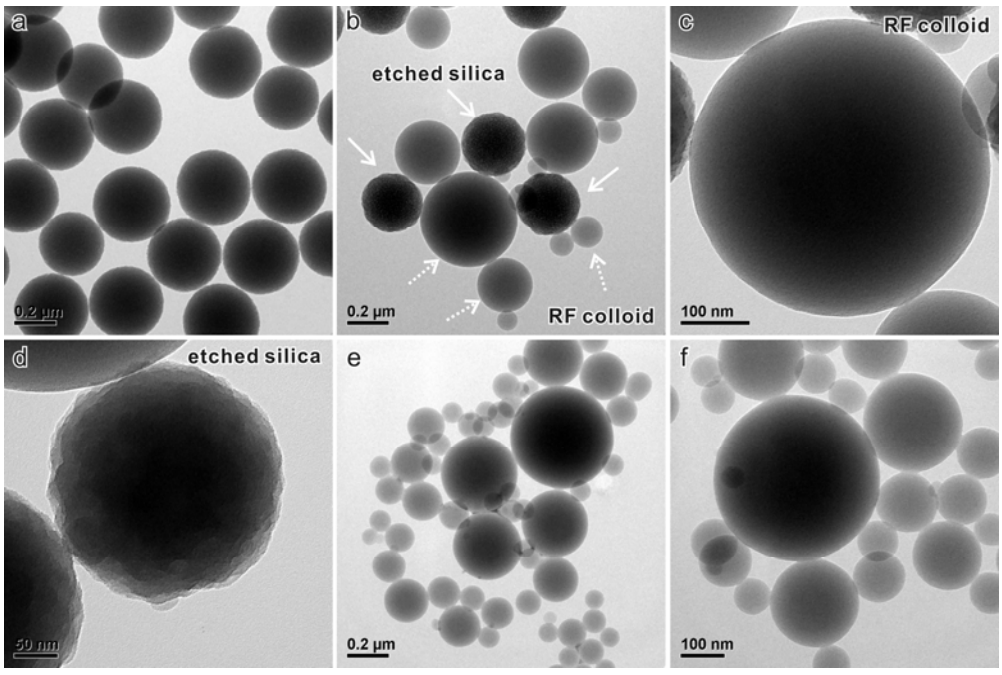

Fig. S4 TEM images: (a) SiO_2 spheres, (b) etched SiO_2 spheres and RF colloids obtained by hydrothermal reaction of phenol and hexamethylenetetramine in the presence of SiO_2 spheres, (c) typical RF colloid, (d) typical etched silica sphere, (e) and (f) etched SiO_2 spheres and RF colloids treated by HF aqueous solution.

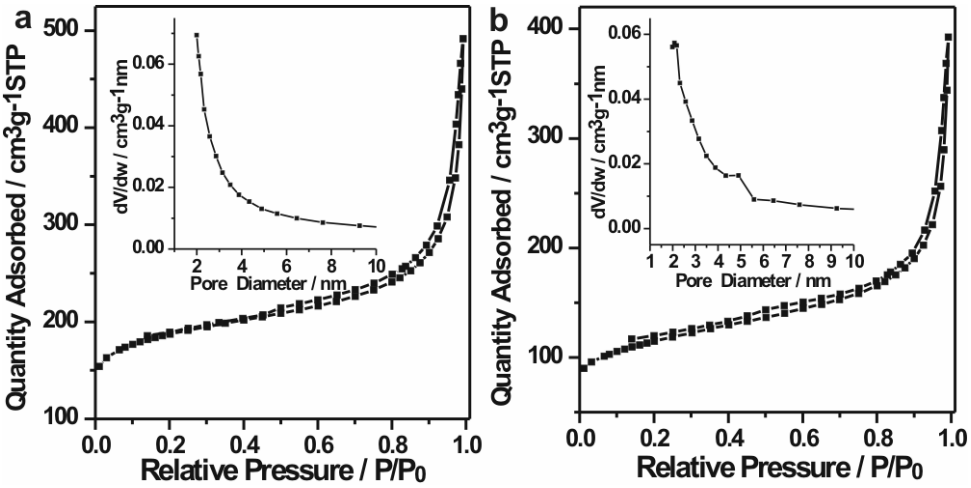

Fig. S5 N_2 sorption isotherms of HCS-260 (a) and HGS-260 (b), inset: the pore size distribution.

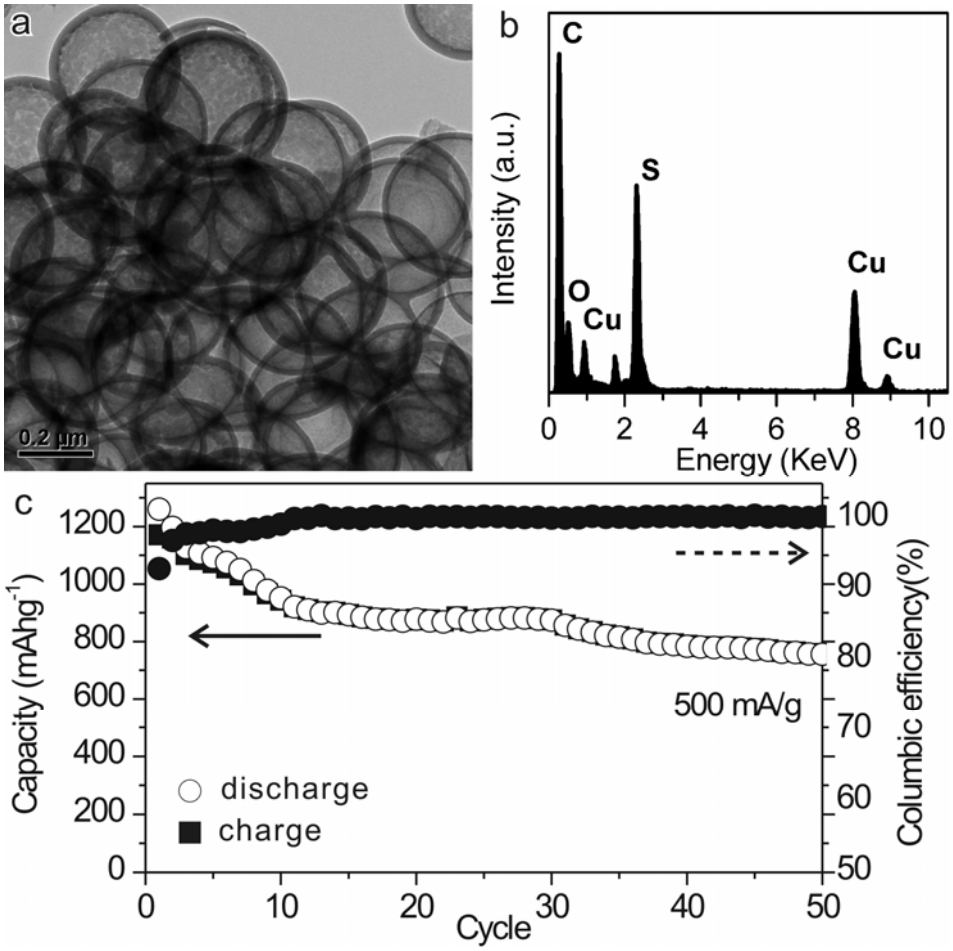

Fig. S6 TEM image (a) and EDX spectrum (b) of HCS-260/sulfur composites, (c) cycling performance of lithium-sulfur batteries with HCS-260/sulfur cathode.

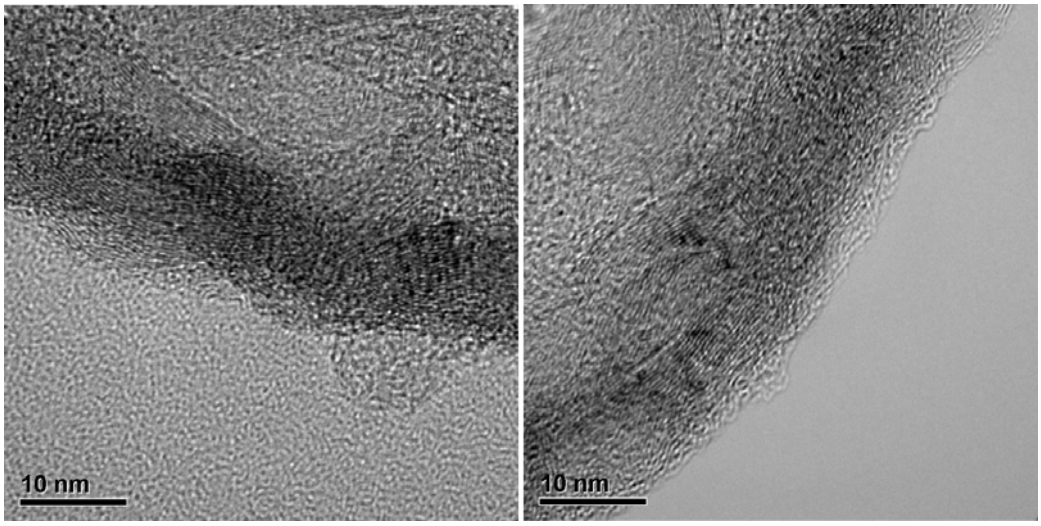

Fig. S7 HRTEM image of HGS-260

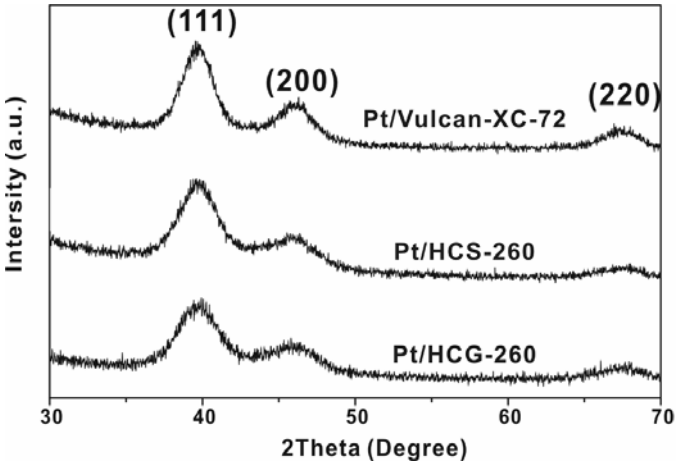

Fig. S8 XRD patterns of Pt/HCG-260, Pt/HCS-260, and Pt/Vulcan-XC-72

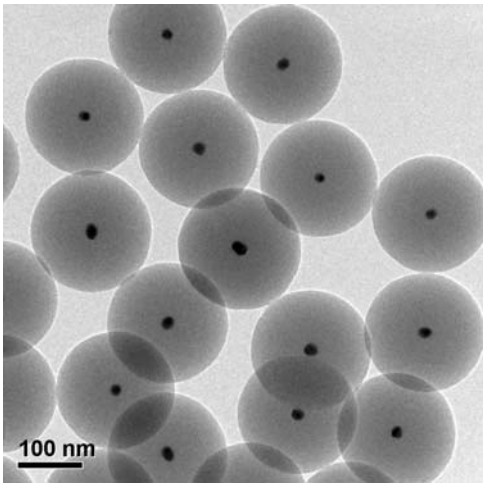

Fig. S9 TEM image of Au@SiO_2.

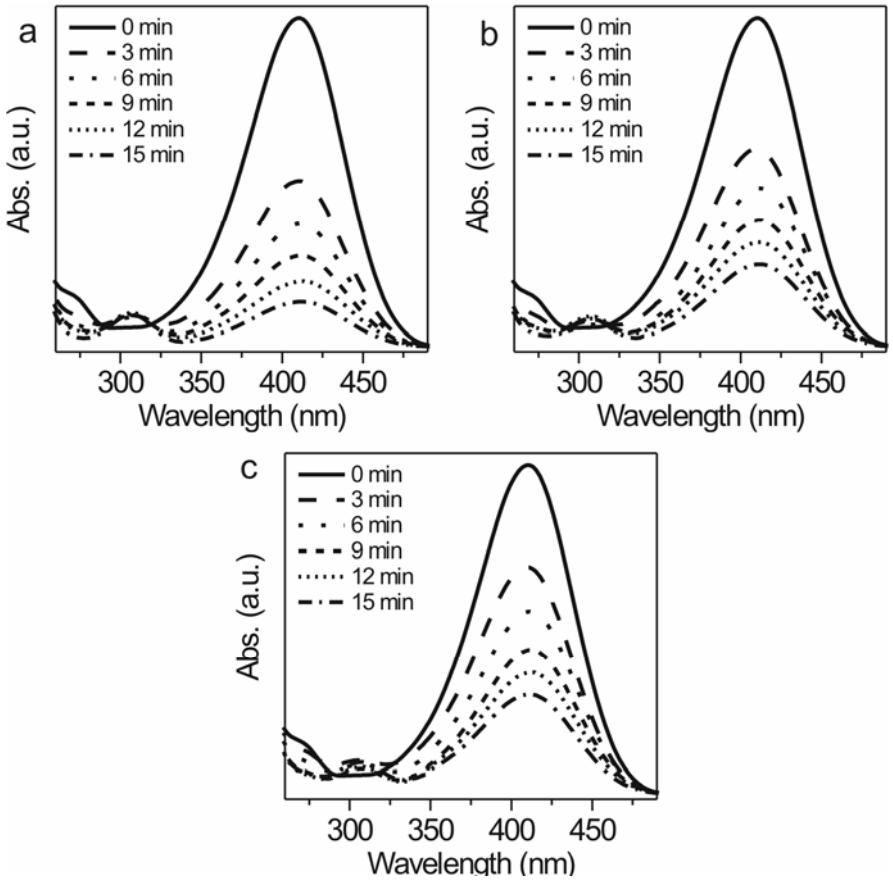

Fig. S10 UV-vis spectra showing gradual reduction of 4-nitrophenol with Au@HCS: (a) Au@HCS-II, (b) Au@HCS-III, (c) Au@HCS-IV.